

SCIENCE.

FRIDAY, MAY 28, 1886.

COMMENT AND CRITICISM.

THE ELECTION OF A PRESIDENT of a college or university, especially in the case of one so venerable and distinguished as Yale, is an event of great importance. Under the present constitution of our colleges, — and it is by no means so faulty as some persons declare it to be, — the presidents not only govern, but they represent their institutions. The president's voice is generally the controlling influence in matters of academic policy and discipline, in financial matters, and in the selection of professors and subordinate officers: therefore his importance and sphere of activity are not limited to his own college, but are co-extensive with the wide boundaries of higher education. This fact has entered, though perhaps unconsciously, into the popular interest which has been manifested as to the choice of the Yale corporation for the succession to President Porter. Undoubtedly the activity of the younger alumni of Yale has served to keep the matter prominently before the public, but we know that in the university world, at all events, considerations higher than merely personal ones have been taken into account.

On Thursday of last week the matter was settled by the election of Rev. Timothy Dwight, professor of sacred literature in the Yale theological school, to the presidency of Yale college. Professor Dwight's election cannot be called unexpected, for the well-informed had some months ago settled upon him as the coming man. But there are elements in the choice which make it a peculiarly happy one. In the first place, no college, however progressive, can afford to break entirely with its past, to which, after all, it owes its present. The fact that Professor Dwight graduated from Yale in 1849, and has for more than thirty years been connected with the college as tutor and professor, identifies him sufficiently with the traditional policy of Yale to insure that it will not be inconsiderately abandoned. Then there are elements in the newly chosen president's personal views and opinions which promise that

Yale will not be left behind in the race of development. He has carefully considered the details of university policy and organization, and we may be sure that he will guide Yale on the forward path as rapidly as the college can travel — but no more rapidly. That is the great point: Yale must grow and develop, but she must not lose her character in the process. Educated men throughout the country look to President Dwight to secure this happy mean.

IMITATION BUTTER.

THE manufacture of substitutes for butter originated with the production of the so-called oleomargarine, by the French chemist Mège-Mouriez, from beef-tallow. During the siege of Paris by the Germans, the making of this artificial butter was carried on upon a considerable scale, and was first brought prominently into notice. The manufacture of oleomargarine commercially, however, did not cease with the necessity which gave birth to it, but with various modifications has increased in amount, until now it is believed to have seriously damaged the dairy interests of the country; and congress is being urged to pass a bill, which, under the guise of a revenue law, is really a prohibition law. The agitation has attracted such general attention, both from dairymen and from consumers of butter, and so much misrepresentation and flaming rhetoric have been called forth, that it may be worth while to consider calmly what are the facts in the case.

Process of manufacture. — Although numerous patents have been taken out for the manufacture of imitation butter, and a great variety of materials have been named in the specifications, the process as now conducted is comparatively simple. The raw materials are beef-tallow, leaf-lard, and the best quality of butter, together with small amounts of milk or cream and of butter-color.

From the beef-tallow is prepared the oleomargarine oil of Mège. The caul fat of freshly killed beeves is, after thorough washing, first in tepid and then in iced water, allowed to hang in a cold room until thoroughly cold. It is then rendered at a temperature between 130° and 175° F. The resulting oil is allowed to cool slowly until a considerable portion of the stearine and palmitine have crystallized out, and the pasty mass is then subjected to hydraulic pressure. The still fluid portion (about two-thirds of the whole) flows

out into a tank of cold water, where it solidifies into a granular mass which is known in the trade as 'oleo-oil,' or simply 'oleo.' The name 'oil' is somewhat misleading, as the product is a granular solid of a slightly yellow color. Fresh leaf-lard, treated in substantially the same way as the beef-tallow, yields the 'neutral lard,' or 'neutral,' of the trade, also a granular solid of a white color.

The objects of this treatment are twofold, — first, to produce fats as free as possible from taste or odor; second, to remove some of the difficultly fusible stearine and palmitine in order that the finished product may melt readily in the mouth.

Having thus secured the fats in proper condition, the manufacturer proceeds to mix the 'oleo' and 'neutral,' — the proportions varying according to the destination of the product; a warm climate calling for more 'oleo,' a cold one for more 'neutral,' — and to flavor the mixture with butter. This flavoring is conducted in large, steam-jacketed vessels provided with revolving paddles, by which their contents can be thoroughly agitated. Here the 'oleo' and 'neutral' are melted, and thoroughly agitated with a certain proportion of milk, or sometimes of cream, and a proper amount of butter-color. Forty-eight gallons of milk per two thousand pounds of product are stated to be a common proportion. After sufficient agitation, the melted mass is run into cold water, and as it cools is broken up by paddles so as to granulate the mass. After thorough washing, it is salted and worked exactly like butter. The product is known as oleomargarine. Although it contains hardly more than a trace of butter-fat, the latter flavors the whole mass so strongly that when well salted, as it usually is, it might readily pass with an inexperienced or careless consumer for a rather flavorless butter. Oleomargarine is the cheapest product made. By adding to the material in the agitator, or 'churn,' more or less pure butter, what is known as butterine is produced, two grades of which are commonly sold; viz., 'creamery butterine,' containing more, and 'dairy butterine,' containing less butter.

Healthfulness. — Very exaggerated and absurd statements have been made, especially by the dairymen and their organs, regarding the unhealthfulness of butterine and oleomargarine. The charges have in general been, that the fat used is practically uncooked, and that raw animal fat is unwholesome; that filthy fat, and fat from diseased animals, are used, and that the product contains, or is liable to contain, the germs of disease; and that, in cleansing these diseased and filthy fats, dangerous chemicals are used, which are not subsequently completely removed.

That the fats used are of themselves unwholesome, there is no proof whatever. They contain nothing that butter-fat does not also contain, and differ from it only by the absence of about six per cent of the glycerides of certain soluble fatty acids; viz., caprinic, caprylic, capronic, and butyric acids. The only experiments upon the digestibility of imitation butter are two, by A. A. Mayer, upon oleomargarine. These showed a difference of only about two per cent in favor of butter. That the higher flavor of butter acting upon the nervous system would give it a greater nutritive value than the flavorless 'neutral' or 'oleo,' may be conceded; but that an article which even experts fail to distinguish from genuine butter is at any serious disadvantage in this respect, may well be doubted.

The manufacturers claim that imitation butter can only be made from the best quality of fat from freshly killed animals, and I know of no evidence which disproves their assertions. The sensational article recently published in a prominent agricultural paper in the north-west, accompanied by cuts of the numerous organisms found in butterine, is of no significance in this connection, both because the species described are all harmless, and because no comparative examinations of genuine butter were made. It is highly probable that many samples of the latter would show as miscellaneous an assortment of formidable-looking, harmless organisms as did the butterine.

On the other hand, however, there is at present no guaranty, except the statement of the manufacturers, that diseased fat is not or can not be used; the manufacture being conducted entirely without any official inspection, and visitors being in most (not all) cases excluded. I believe that the chances of disease being conveyed in this way are small, but they are not yet proved to be nonexistent.

As regards filthy processes of manufacture, it may safely be asserted that butterine could not successfully imitate butter were it not as clean as most things are which pass for clean in this dirty world.

The charge that dangerous chemicals are used in the manufacture may be disposed of in a few words. If a dangerous amount of any chemical which is claimed to be used were left in the finished product, the latter would be inedible. Should traces of these chemicals be found, their significance would not lie in themselves, but in the indication they would furnish that the original fats were impure and required chemical treatment.

Fraudulent sale. — The evil feature of the trade in imitation butter is that it is largely fraudulent.

A prominent manufacturer of butterine lately told the writer, in response to an inquiry, that, in his opinion, not over twenty-five per cent of the butterine made in the United States is sold under its true name. It may safely be assumed that the estimate is not too low, and that fully three-quarters of the product is eventually sold and eaten as butter. Reliable statistics of the production of imitation butter are not to be obtained, so far as I have been able to find, but it must be enormous. The fact, which is stated on good authority, that Chicago, one of the chief seats of the manufacture, exports more 'butter' than it imports, is suggestive in this connection. The manufacturer, it may be assumed, sells his product as an imitation, though even here facilities for deception are afforded in the use of such names as 'creamery' and 'dairy' butterine, and in the branding of packages with the names of imaginary creameries. But as the imitation passes through the hands of jobber, retailer, and restaurant or boarding-house keeper, to the consumer, it undergoes a transformation, until, at the end, it is the exception when it is not butter simply, with no suffix. Since the imitation can be produced much cheaper than the genuine article, and can with difficulty be distinguished from it, it affords a tempting opportunity to the middleman to increase his profits. As a natural result, the manufacture of and trade in genuine butter have suffered under this unfair competition, and a wide-spread change in the butter trade of the cities is taking place. Consumers, wisely or unwisely, are generally very averse to eating butterine at all, as well as to paying the price of butter for it, and in self-defence are coming more and more to make contracts for butter directly with reliable producers, to the benefit of both parties and the injury of the middlemen, who seem now to be in a fair way to reap as they have sown.

Legislation. — The undoubted injury to the dairy business wrought by the manufacture and fraudulent sale of butterine and oleomargarine has been the incentive to an earnest search for a remedy; and the aid of legislation was speedily invoked, first in the shape of laws to compel the branding of every package of these articles, and, later, of laws prohibiting entirely their manufacture and sale. Neither class of laws proving effective, and the New York law having been pronounced unconstitutional by the court of appeals, the aid of national legislation is now being invoked.

Several bills upon this subject have been introduced into the present congress; but the one which has become most prominent, and has apparently met with the most favor from the oppo-

nents of butterine, is the substitute bill reported by the committee on agriculture, by which it is intended to indirectly prohibit the manufacture of imitation butter. There are numerous minor provisions; but the main ones, which render all others superfluous, are the imposition of a license-fee of six hundred dollars upon every manufacturer, four hundred and eighty dollars upon every wholesaler, and forty-eight dollars upon every retailer, and of an internal revenue tax of ten cents per pound upon all imitations of butter manufactured or imported, the tax upon the latter being in addition to the customs duty. The internal revenue department is charged with the execution of the law. In short, it is proposed to tax the business out of existence.

The writer does not hesitate to express his belief that the enactment of this law is not desirable. As is evident from the description already given of the process of manufacture, and as the writer is convinced by personal inspection, imitation butter, when properly made, or when made as the manufacturers claim that it is, is a perfectly cleanly, wholesome article of food. Granting this, the prohibition of its manufacture is simply class legislation, designed to advantage the producer of butter by increasing the price of his product, to the detriment of the consumer. The dairy interest of the country is undoubtedly of great magnitude, and may well be fostered in all legitimate ways; but no interest has the right to be 'protected' at the expense of the whole people.

Another objection to a heavy tax on this article, unless it be absolutely and hopelessly prohibitory, is that it will tend to stimulate exactly what appears to be now the greatest danger connected with the manufacture of butter-substitutes. In addition to the pressure of competition, we should have the pressure of taxation forcing the manufacturer to seek cheaper and cheaper sources for his raw materials, and tempting him to use unhealthy fats, if he can do so without detection.

Further, the writer ventures to doubt whether the permanent injury which this manufacture will work to the dairy interest will be so great, or the advantage of its suppression so marked, as is commonly supposed, provided that the imitations are compelled to be sold for what they are. Butterine, undoubtedly, has depressed the price of butter, partly by displacing it, and partly by creating a general distrust of the genuineness and wholesomeness of what is offered to the consumer as butter. It is worth considering, however, to what extent this would be offset, in time, by the increased consumption of butter, both *per se* and in butterine, which will presumably follow from its lower price.

But while the writer does not advocate legislative prohibition, he does most strongly believe in the necessity for legislative regulation. The objects to be attained by such regulation are, first, to insure that only clean and wholesome materials are used in the manufacture, and that the process is conducted in a careful and cleanly manner; and, second, to compel the sale of the product under its own name and on its own merits. When this is done, all is done that the state can properly do.

Space forbids entering into any discussion of the best methods of reaching these objects. Some system of registration and inspection of factories would evidently be necessary to accomplish the first; while the second might be attained by compulsory branding of packages, use of a peculiar style of package, requiring manufacturer and jobber to keep a record of all packages sold, with name of buyer, and numerous other devices. Probably both these objects would be most readily accomplished by putting the whole matter in the hands of the Internal revenue bureau, while it might fairly be taxed sufficiently to cover the cost of inspection, etc.

Finally, it is to be remembered that butterine is but one of many forms of food-adulteration. The most satisfactory treatment of the subject would be the enactment of general laws, state or national, upon the subject of food-adulteration, and the provision of an efficient power to enforce them.

Methods of detection. — There is no simple test by which the consumer may determine for himself whether a sample of butter is genuine: the adulteration can be detected only by the expert chemist or microscopist. Butter, as already noted, differs from all other animal and most vegetable fats, in containing about six per cent of the glycerides of certain soluble fatty acids. It is upon this fact that all chemical methods for the detection of butter-adulteration are based. The original method, as proposed by *Hehner*, consisted in determining the percentage of insoluble fatty acids. In butter this averages about 87.5 per cent, while in other animal fats it averages about 95 per cent. *Koettsdorfer* determines the weight of pure potash required to saponify one gram of the fat. Owing to the lower molecular weight of the peculiar acids of butter, more potash is required to saponify this fat; the range being 221 to 232 milligrams of potash for butter, and 195 to 197 for other fats. *Reichert*, after saponifying the fat and setting free the fatty acids again by addition of sulphuric acid, all the operations being conducted in a uniform manner, distils over a fixed volume of the resulting liquid, and determines the amount of potash required to neutralize it. The distillate

from 1 gram of butter-fat requires 13.0 to 14.9 cubic centimetres of a deci-normal potash solution; that from other fat, a fraction of 1 cubic centimetre.

Of these methods, *Hehner's* is too tedious for ordinary use; *Koettsdorfer's* is very readily and quickly applied, and in general gives unequivocal testimony as to the genuineness of the sample; *Reichert's* requires somewhat more time and skill than *Koettsdorfer's*, but still is a simple method, and gives trustworthy results, and has advantages in certain cases.

The results obtained by either of these methods may evidently serve as the basis of an approximate computation of the extent of the adulteration. Owing to the somewhat variable composition of butter, however, the approximation cannot be a very close one, and slight adulterations would pass undetected. It will not often be the case, however, that butter is slightly adulterated; so that practically but little difficulty will arise from this fact, so far as the detection of the falsification is concerned. For a calculation of the extent of the adulteration, *Reichert's* method has proved the more satisfactory in my laboratory, *Koettsdorfer's* giving usually decidedly too low results.

*Cornwall*¹ has recently called attention to the fact that cocoanut-oil is said to be used in the manufacture of butterine. This oil, unlike most others, contains a considerable proportion of soluble fatty acids; and mixtures of this fat with oleo-oil or neutral may be made which behave exactly like butter with *Hehner's* or *Koettsdorfer's* tests. They may be distinguished, however, according to *Cornwall*, by *Reichert's* method, the soluble acids being much less volatile than those of butter; the distillate containing, consequently, but little of them.

Besides the chemical methods, the more important of which have been described, various attempts have been made to devise optical tests, but with indifferent success. Among others, *Dr. Thomas Taylor*, microscopist of the U. S. department of agriculture, has described a method which has received such extensive notice as to merit a few words. He proceeds substantially as follows: some butter is melted and 'boiled' for a short time (that is, the water which it contains is boiled), and then allowed to cool slowly. A small portion of the solidified butter is mounted in a little olive-oil on an object-glass, and under the microscope is seen to consist of irregular globular masses consisting of aggregations of fat-crystals. When these are examined with polarized light in the dark field, each shows a pretty well defined St. Andrew's cross. *Dr. Taylor's* original claim was that these globules, and particularly their ap-

¹ Report of New Jersey state board of health.

pearance by polarized light, were peculiar to butter, and could serve as a means of distinguishing it from imitations; and the commissioner of agriculture, in his last report (p. 36), states, that, at the time of writing, two convictions for violations of the butter-laws had been secured in the District of Columbia by the aid of Dr. Taylor's method.

Professor Weber, of the Ohio state university, however, has recently shown that lard and oleo-oil do not differ essentially from butter in this respect. By 'boiling' the butter as Dr. Taylor directs, some of its water is removed, and a formation of minute salt-crystals takes place. As the butter cools, these minute crystals of salt serve as nuclei for the formation of the butter-globules. Professor Weber shows that if melted lard or tallow be allowed to cool under the same conditions, they too form globules which exhibit the St. Andrew's cross.

In an open letter to Dr. E. Lewis Sturtevant, director of the New York agricultural experiment-station, Dr. Taylor attempts to break the force of Professor Weber's experiments, and also shifts his ground, claiming that the distinguishing difference between butter and other fats under the microscope is that the former, when viewed by polarized light through a selenite, shows a uniform tint, while the latter exhibits prismatic colors.

Whether this claim rests on any better foundation than the former, the writer will not undertake to say; but it is plain that further investigation would not be out of place.

H. P. ARMSBY.

ENGLAND'S COLONIES.

THE opening of the Colonial and Indian exhibition at South Kensington gave rise to an article in the London *Times*, on the growth of England's colonial possessions. The Portuguese and Spaniards, and even the French, were in the field long before England. Spain had a settlement in Dominica as early as 1493, and Vasco da Gama reached India in 1498. Within very few years India and South America had their Portuguese and Spanish viceroys. In 1534 Jacques Cartier made his famous voyage up the St. Lawrence, taking possession of the country in the name of the French sovereign. True, Cabot discovered Newfoundland and the mainland of North America in 1497; but he, like other early western navigators, simply regarded the new world as a barrier on the way to India. It was this latter land of fabulous riches that was the goal of the infant naval enterprise of England for many years after Cabot's discovery. The Portuguese monopolized

the routes by the southern seas, and England had not yet a navy to cope with its rival.

So effort after effort was made, in craft not much more formidable than cock-boats, to find a passage to India either by the north-west or north-east. Not till our own days have these passages been sailed over; but long before had they been given up as hopeless routes to China and India. Many a life did these early attempts cost England; but to them, no doubt, is greatly due the rapid progress she made as a naval power.

Up to the end of the sixteenth century, while Portugal and Spain were rapidly extending their sway in Asia and America, England had only a doubtful possession of Newfoundland along with powerful French rivals. Even Sir Humphry Gilbert's attempt to effect a settlement on the island in 1583 can hardly be regarded as other than abortive, though it gives Newfoundland a claim to be regarded as the earliest British colony. The first effective English settlement on the island cannot be dated earlier than 1623, long before which Virginia had been planted and Jamestown founded. True, in 1580 the British flag was planted in the West India island of Tobago, but that island was not effectively occupied by England till 1763.

Meanwhile, some roving Englishmen had in 1605 planted a cross in Barbadoes, inscribed 'James, king of England and of this island,' though there was no actual settlement till 1625. Barbadoes is one of the two or three British West India islands that never changed hands. After all, however, Bermuda may fairly claim to be considered the earliest of existing English colonies, as it was colonized both from Virginia and England shortly after 1609. But later, during the seventeenth century, the growth of England's colonial possessions was slow, if we except the New England states and the settlements on the east American coast to the south. Leaving these last out of view, her colonies at the close of the century were few and scattered, compared with the enormous territories which Portugal and Spain, France and Holland, were endeavoring to drain of their wealth. Even in India, during the seventeenth century, she can hardly be said to have got beyond the factory stage. The East India company were simply lease-holders of the native princes. Newfoundland, as already indicated, was only permanently settled in 1623, fourteen years after the planting of Bermuda. In the same year an English colony was planted in Nova Scotia, which then included New Brunswick, though it was only at the peace of Utrecht (1713) that England can be said to have obtained undisputed possession.

With one or two exceptions, England's footing in the West India Islands during the seventeenth and even the eighteenth centuries was exceedingly unstable: they were being continually banded about between England, France, and Spain before the final adjustment at the beginning of the present century. As stated above, an effective settlement was made in Barbadoes in 1625. Two years previously some Englishmen established themselves in St. Christopher's, which, however, was not finally ceded to Great Britain till 1713. Between 1628 and 1650, Nevis and Turk's Island, Antigua, Montserrat, St. Lucia, and Anguilla received English settlers, though St. Lucia, at least, changed hands several times before finally becoming English, in 1803.

Crossing over to Africa, we find, that, as early as 1588, Queen Elizabeth granted a patent to a company to trade to the Gambia; but no settlement seems to have been established till 1631, and even that can hardly have come to much, since a resettlement was made in 1817. Still there was a very considerable trade between England and West Africa in the seventeenth century, and Gambia and other stations became notorious as centres of the slave-trade. But their value for colonizing and trading purposes soon sank far below that of the West Indies and other annexations.

St. Helena became hers by capture in 1651; and four years later (1655) Jamaica, the largest and richest of her West India possessions, capitulated to an expedition sent out by Cromwell. English factories seem to have been established on the Gold Coast in 1661, and her first settlement on the Virgin Islands dates from 1668. A small English colony was planted in New Providence in the Bahamas in 1629, though she had frequently to give up possession before the islands finally became hers, in 1783.

Meantime, England was rapidly extending her sway over the eastern coast of what is now the United States; and these possessions, even in the seventeenth century, were of far greater importance than all her other acquisitions.

At the end of the seventeenth century, then, besides Newfoundland and Bermudas, and a few factories on the West African coast and in India, of the present colonial empire England had possession, more or less stable, of Jamaica, Barbadoes, St. Christopher's, Nevis, Turk's Island, Antigua, Montserrat, Anguilla, Virgin Islands, Bahamas, and St. Helena out in the Atlantic. The total area of these did not much exceed sixty thousand square miles, for her African and Indian settlements were little more than stations. Even if we added such parts of Nova Scotia and New Bruns-

wick as were not occupied by France, the total area could scarcely be more than eighty thousand square miles.

During the first half of the eighteenth century, if we except the confirmation to Great Britain of the ten North American colonies just mentioned, and one or two of the West India islands already included, the only acquisition of importance as a foreign possession was Gibraltar (1704), and that not as a colony, but as a strategical station.

A period of comparative quiescence prevailed during these fifty years previous to the outbreak of the great and long-continued struggle between England and France for supremacy on the seas, if not on land. During the first half of the eighteenth century The East India company's business was steadily extending in India. Comparatively few additions were made to the English possessions on the North American coast. France claimed all Canada, only tolerating the station of the Hudson's Bay company, founded in 1670, and holding the Alleghanies as the western limit of English dominion. The position in the West Indies remained essentially unaltered, though the development of the English plantations in that region was proceeding with profitable activity. The few factories on the West African coast were of little account, the Dutch were still supreme at the Cape, and Cook was only beginning his career in the Royal navy.

During the last forty years of the eighteenth century, on the other hand, the broad foundations of England's empire beyond the seas were firmly laid; subsequent operations have mainly been in the way of development and consolidation. The great struggle between England and France for supremacy beyond Europe may be said to have begun simultaneously in India and Canada. On the latter field it resulted in the capitulation of Quebec in 1759, followed four years later by the cession of the whole of Canada; so that England was virtually mistress of the whole of North America. In 1776 the declaration of independence was signed, and in 1783 England had to resign herself to the loss of by far the most valuable half of her dominions in America.

In the same year as Canada became an English possession, the islands of Dominica, Granada, St. Vincent, and Tobago were added to her West Indian possessions, followed in 1797 by the surrender of Trinidad to Abercrombie by the Spaniards. Although Commodore Byron took possession of the Falkland Islands in 1765, no effective establishment was formed there till 1833. In 1783-86 British Honduras was acquired by treaties; in 1787 Sierra Leone was ceded by the native chiefs; while in 1788, not quite a century ago, the not

very promising foundation of the great Australasian group of colonies was laid by the establishment of a small convict establishment at Botany Bay.

Turning to the east, we find Malacca captured from the Dutch in 1795, though it did not finally become English till 1823. Penang was colonized in 1785, and Province Wellesley in 1798. Much more important was the capture of Ceylon from the same once supreme colonial power in 1796. The battle of Plassey was fought in 1757, and within about half a century thereafter, through the genius of Clive and Hastings and Wellesley, English supremacy was virtually established, directly or indirectly, over a great part of the Indian peninsula. Bengal was ceded in 1765, and Madras conquered in 1792-1800, having between them an area estimated at two hundred and ninety thousand square miles, and a population of fifty-five millions.

Thus, then, during the latter half of the eighteenth century, England had succeeded in rapidly increasing her foreign possessions by something like six and a half millions of square miles, reckoning the whole of Australia as virtually annexed. During the present century she has been able to increase this area by about one-third, half of it, at least, in India. While, during the last eighty-six years, she has been extending and confirming her hold over India, and while she has acquired one or two really important additions to her colonial possessions, it will be seen that her chief work has been to develop and consolidate the acquisitions of the latter half of the eighteenth century.

In the West India region, British Guiana was finally annexed in 1803, and St. Lucia in the same year, thus completing the present list of her possessions in that quarter. Also in 1803 the first settlement was established in Tasmania. While in this quarter, twenty-six years later (1829) West Australia was settled, followed, seven years after (1836), by the modest beginnings of South Australia at Port Philip. In 1841 New Zealand began her wonderful career as a British colony. Ten years later (1851) Victoria separated from New South Wales, and set up for herself, — an example followed by Queensland in 1859. In 1806 the Dutch were compelled to hand over to England their possessions in South Africa, which by the formation of the Natal colony in 1838, and other subsequent annexations, have been extended far beyond their original boundaries. In 1807 England captured the tiny islet of Heligoland, and three years later (1810) Mauritius capitulated, her possession of the island being confirmed by the treaty of Paris, 1814. A year later (1815) she acquired the Ionian Islands by treaty, only to give

them up to Greece some fifty years after; and in the same year she established her naval station in Ascension. Singapore was settled in 1818, and the Falklands in 1833. Aden as an outpost of India was occupied in 1833. Labuan was ceded in 1846, followed by Lagos in 1861, and Fiji in 1874. The Straits Settlements were detached from India in 1867, and set up for themselves as a separate colony; and in 1874 the native states of Perak, Selangore, and Sungei Ujong, were placed under its protection.

We all remember the excitement over the occupation of Cyprus in 1878; and while England pays tribute for it to the sultan, her real relation to the interesting island is indicated by the fact that it figures among her other colonies at South Kensington. The British North Borneo company was incorporated by royal charter in 1881; and the fact of its having a court to itself at South Kensington may be taken as a tacit admission that its territory is reckoned among her colonies. England has hardly yet recovered from the excitement of raising the British flag over southern New Guinea, the Niger mouths, and Bechuanaland, in 1884; while at this very moment her soldiers and civil servants are busy getting into working-order the extensive territory of upper Burmah, proclaimed English on the first day of the present year. This last annexation, however, belongs rather to the record of her dominion in India, which has advanced so rapidly that the two hundred and ninety thousand square miles and the fifty-five million inhabitants of 1800 have grown to something like a million and a half of square miles and two hundred and eighty millions of population. To the above might be added such outlying spots as the Kuria-Muria Islands, the Keeling Islands, and Port Hamilton, in Asiatic waters; Berbera on the north-east African coast, and Socotra off it; the islands of Rotumah, Auckland, Lord Howe, Caroline, Starbuck, Malden, and Fanning, in the Pacific; not to mention the Nicobars and Andamans, attached to India.

Thus, then, while the beginnings of the greatest colonial empire on record go back some three hundred years, by far the greater proportion of England's foreign possessions have been acquired during the last hundred and twenty years.

LONDON LETTER.

THE *conversazione* of the Royal society, on Wednesday evening last (May 12), was even more successful than usual, special pains having been taken to bring together objects of interest. Partly, perhaps, on this account, and also because it was the first reception of the new president, Prof. G.

G. Stokes, the attendance also was unusually brilliant. Prominent among the exhibits was a microscopic section of the third or parietal eye discovered three days previously in the New Zealand lizard, *Hatteria punctata*, by Mr. Baldwin Spencer of the University museum, Oxford, who has described it in full in *Nature* for May 13. Mesial sections of a frozen chimpanzee and a frozen orang-outang, by Prof. D. J. Cunningham, attracted much attention, as did a collection of micro-organisms by Mr. F. R. Cheshire, and of photomicrographs of bacteria by Mr. E. M. Crookshank. To chemists, specimens of the new element germanium, which appears to be the ekasilicium predicted by Mendellieff in his periodic law (lent by Professor Winkler of Freiburg), were specially interesting. Mr. Howard Grubb exhibited a model of the proposed equatorial and observatory for the great 36-inch refractor for the Lick observatory in California, in which *all* the required motions of telescope, dome, and rising floor are effected by water-power, and are controlled by an electrical arrangement, the commutator of which is portable, and carried by the observer, thus obviating the necessity of assistants. Various electrical appliances, such as the powder-magazine lamps of Mr. J. Pitkin, weighing six pounds, and lasting ten hours, De la Rue's chloride-of-silver battery, arranged for electric lighting, and the miner's electric lamp of Mr. Swan, illustrated the advances in practical electricity; the chief object of purely scientific interest in this connection being the voltaic cells, with solid electrolytes, described by Mr. Shelford Bidwell in the *Philosophical magazine* for October, 1885, and the induction bridge of Professor Hughes. Objects connected with the Hell Gate explosion, near New York, exhibited by Dr. H. Sprengel, were shown, and near them was a new and extremely powerful electrical-influence machine with eight disks working within a glass case. Captain Abney and General Festing exhibited their color-photometer; and several series of stellar and solar photographs by the brothers Henry, Janssen, the solar physics committee, Common, Dr. Gill, and others, illustrated the recent advances in celestial photography. Dr. Auer von Welsbach's incandescence system of burning gas, whereby a light of twenty-five candle-power was obtained with a consumption of two and one-half cubic feet per hour, attracted much attention. An ordinary Bunsen flame is used, the incandescence being obtained from a cylindrical 'wick' of net or muslin soaked in a solution of metallic salts, zirconium being one.

The arrangements for the Birmingham meeting of the British association are now completed. On

Wednesday evening, Sept. 1, the president-elect, Sir William Dawson, of the McGill college, Montreal, will deliver his address. The other two evening discourses at general meetings will be on Sept. 3, by Prof. W. Rutherford, on 'The sense of hearing;' and on Sept. 6, by Mr. A. W. Rücker, on 'Soap-bubbles.' The various sections will be presided over by (A.) Prof. G. H. Darwin, (B.) Mr. W. Crookes, (C.) Prof. T. G. Bonney, (D.) Mr. W. Carruthers, (E.) Maj.-Gen. Sir F. J. Goldsmid, (F.) J. Biddulph Martin, (G.) Sir J. N. Douglass, (H.) Sir George Campbell. The meeting will conclude on Wednesday, Sept. 18.

The Colonial and Indian exhibition, opened by the queen on May 4, with an amount of public and state ceremonial not seen since the corresponding ceremony in 1851, well illustrates in many ways the advances in practical science made in the various colonies. The grounds are lighted every evening by 9,700 glow-lamps, which are simultaneously illuminated, the current for which is supplied by four Elwell-Parker self-regulating dynamos, each of which can supply a current of 250 ampères with an electromotive force of 250 volts when running at 300 revolutions. The official catalogue contains a vast mass of statistical information, most carefully compiled, relating to the history, recent advances, and present condition, of India and the chief colonies.

The still exceptional weather deserves a word of comment. On the night of April 30, 13° of frost were registered close to London; on the afternoon of May 7, 79° in the shade, and 130° in the sun, were registered at the same place. The temperature that week was 6° above the average; and at the present moment (May 15) accounts are coming to hand of floods in all parts of the country heavier than have been experienced for many years, by which railway embankments and bridges have been wrecked, while in the north of Scotland and Ireland severe snow-storms have occurred. The details of the ten-minutes hurricane at Madrid two days ago, which uprooted two thousand trees, wrecked several houses, palaces, etc., killed twenty-four people and injured hundreds, and devastated a large country district, read more like those of the American or tropical tornadoes than of any thing known in Europe.

The Iron and steel institute has just been holding its three-days' annual meeting in London, under the presidency of Dr. Percy, who contributed two papers himself, — on steel wire of high tenacity, and on a rare blast-furnace cinder. Mr. F. W. Gordon of Philadelphia furnished an account of some points in American blast-furnace practice. The international character of the institute was shown by the fact that one-third of

the papers were by other than British subjects. Dr. Sorby's paper on the application of very high powers to the study of the microscopical structure of steel was probably the paper of most purely scientific interest.

On May 12 occurred the annual presentations for degrees at the University of London, when a very large number of graduates of both sexes had their degrees formally conferred. The chancellor, Lord Granville, being in attendance on the queen at Liverpool, the ceremony was performed by the vice-chancellor, Sir James Paget, who, after referring to the loss sustained by the university in the deaths of Dr. Carpenter and Dr. Storrar (both noticed at the time in this correspondence), gave some interesting statistics of its growth. It was now fifty years old, and 54,630 students had graduated. In 1838 it only had 23 candidates; in 1860, 788; and in 1885, 3,477. With its numbers its influence had increased, and it attracted students from all the colonies and from India, as well as from England. Among its distinguished graduates were Sir H. Roscoe, Sir W. Jenner, Lord-Justice Fry, and the present lord-chancellor. At the meeting of convocation on the previous day, a scheme for degrees in engineering science was, on the motion of Prof. W. C. Unwin and Mr. W. Lant Carpenter, unanimously adopted, and sent up to the senate for consideration. A movement is in contemplation to celebrate the jubilee of the university.

In an interesting paper given last night before the Society of telegraph engineers, upon long-distance telephony, by Mr. W. H. Preece, the system of trunk-line (American, 'extra territorial') working was described, and some very curious statistics were given. At the end of 1877, 780 telephones existed in the United States, and at the end of 1885 there were 325,570 telephones, and 782 telephonic exchanges. In England at the same date there were only 13,000, or about as many as were used in New York and Brooklyn alone; while Canada, with its population of three millions, employed 18,000. Of European cities, Berlin possessed the most, 4,248, London coming second with 4,193. The most complete development he had seen in any country was in the group of towns of which Newcastle-on-Tyne was the centre. Long-distance speaking was entirely a question of line wire, not of instruments. M. Van Rysselberghe spoke in the discussion, and detailed some of his recent experiments in the states. He is about to connect Paris, Brussels, Amsterdam, and Rotterdam by his simultaneous telegraphic and telephonic arrangements.

The report for 1885, of the inspectors on experiments on living animals, under the vivisection

act, has just been issued. The total numbers of experiments was 800; 210 being done under the restrictions of the license alone, and 82 lecture demonstrations under similar restrictions. In all, except those under a special certificate, the animal is rendered insensible during the whole of the experiment. In most of the experiments where anaesthetics were dispensed with, the operation was simple inoculation or hypodermic injection; so that the number of animals that suffered any appreciable pain was 35 or 40, and these, for the most part, frogs. Although the number of experiments in 1885 was nearly double that in 1884, there was no increase of suffering to the animals employed.

The report of the inspector of fisheries has just been issued, and gives interesting details on the trade in eels between London and the continent. From Holland 1,000 tons are sent annually to Billingsgate (London) alone, the total annual value of eels consumed in England being about two and a half million dollars. An admirable contrivance is described for reviving them from their exhausted condition on arrival. At the Society of arts this week, Mr. J. Willis Bund read a paper on the proposed fishery board for England and Wales, showing that their fisheries had relations at present with at least five government departments: viz., the home office, the foreign office, the admiralty, the customs, and the board of trade. The total value of the English and Welsh fisheries was probably between eight and ten million dollars, but an annual statistical account of them was a very great want.

Mr. W. Bateson of St. John's college, Cambridge, is about to proceed to Central Asia for the purpose of investigating the fauna of the Sea of Aral and the smaller lakes in its neighborhood. Mr. Bateson is already well known as a morphologist, having paid two visits to the Chesapeake zoölogical laboratory of the Johns Hopkins university for the purpose of studying the development of the American species of *Balanoglossus*; and he now proposes to collect large numbers of the Mollusca and Crustacea of the Central Asian lakes, for the purpose of studying the range of variation within specific limits.

W.

London, May 14.

NOTES AND NEWS.

ALTHOUGH the university of the state of New York exists only on paper, yet its annual convocations are meetings of considerable scientific interest and importance. This year the convocation will be held at Albany on July 6, 7, and 8. The announcement includes the following important papers, all of which will be followed by a discus-

sion of the subjects presented: Tact in teaching, by Rev. Brother Noah, professor of English literature in Manhattan college; Manual training, by Principal S. G. Love of the Jamestown union school; The present status of entomological science in the United States, by J. A. Lintner, Ph.D., state entomologist; Has the college a logical place in the American system of education? by Prof. Oren Root, Ph.D., of Hamilton college, and Prof. S. G. Williams, Ph.D., of Cornell; The 'natural method' of teaching languages, by L. Sauveur, president of the College of languages, New York City, and Principal George C. Sawyer of the Utica free academy; The educational uses of museums of natural history, by James Hall, director of the New York state museum of natural history; Systematic habit in education, by Principal E. H. Cook of the Potsdam normal school; Elective studies in college, by President James McCosh, LL.D., of the College of New Jersey; The mutual relations of the colleges and academies, by President Charles K. Adams, LL.D., of Cornell university. There will also be a conference upon college education in the state of New York, which will be presided over by Chancellor Sims of Syracuse university, who will open the discussion as to the classical requirements for the degree of A.B. Among those who intend to participate in the conference and discussions are Presidents Dodge of Madison university, Darling of Hamilton, Potter of Hobart, Fairbairn of St. Stephen's, Ryan of Niagara university, Webb of the College of the city of New York, Adams of Cornell, Taylor of Vassar, and Forsyth of the Rensselaer polytechnic institute.

—The Indiana academy of sciences held its field-meeting at Brookville, May 20 and 21. The days were spent in field-work, and the academy held meetings at the town-hall in the evenings. On the evening of May 20, the academy was welcomed by D. W. McKee, president of the Brookville society of natural history. To this President D. S. Jordan responded. Prof. J. C. Branner delivered an address on "The relations now existing between geologists and the people." Friday evening Prof. D. S. Jordan delivered an address on 'Darwin,' which was discussed by Prof. D. W. Dennis. Prof. Jordan then spoke concerning the different methods employed in catching fish. Prof. Branner gave an account of the ways in which corals are procured. Prof. P. S. Baker spoke of 'The progress of toxicology.' The academy will hold its annual meeting at Indianapolis in December next.

—The opening of the Carnegie laboratory a year ago, and the endowment of hospitals by the Van-

derbilt family, have been followed by the announcement of two new laboratories for the advancement of medical science, — one in Brooklyn, and the other in New York. The former will be known as the 'Hoagland laboratory of the Long Island college hospital,' and is the gift of Dr. C. N. Hoagland, a physician of Brooklyn. It will be devoted to bacteriological, physiological, and pathological purposes, and will be equipped with all the best modern appliances, together with a select library and museum. It is intended not only as a means of teaching the students of the college, but also as a place where physicians and others desirous of prosecuting original investigation can find the necessary apparatus and facilities. The new laboratory to be established in New York is to be known as the 'Loomis laboratory,' and is to be in connection with the University medical college. The name of the donor is still unknown, but the name it is to bear is a tribute of respect to the well-known teacher, Prof. A. L. Loomis.

—The first annual meeting of the University science club, of the University of Kansas, was held Friday, May 21. The programme, as arranged, was as follows: E. H. S. Bailey, On the viscosity of fats and oils; L. L. Dyche, Methods of studying the food-habits of birds; J. D. McLaren, Notes on *Pogonomyrmex occidentalis* (agricultural ants of Kansas); Richard H. Short, A determination of the force of gravity on Mount Oread; R. L. McAlpine, A determination of the accuracy of the solar attachment to the engineer's transit; E. C. Franklin, on a variety of orthoclase from Hadam, Conn.; L. E. Sayre, A new appliance for the rapid collection of precipitates; F. H. Snow, The transitional character of the essential organs in the white maple (*Acer dasycarpum*); W. S. Franklin, A modification of Le Clanche battery; F. O. Marvin and Richard Birbeck, Gauging of the Kansas River; V. L. Kellogg, Bird parasites; J. D. McLaren, The structure of *Unio laevis*; E. L. Nichols and W. S. Franklin, On the influence of magnetism upon electromotive force; E. H. S. Bailey and S. H. Wood, Note with reference to the effect of boiling upon the solubility of tannin in coffee; F. H. Snow, Some results of eighteen years of meteorological observations at Lawrence, Kan.

—The following comprise the latest changes in the coast and geodetic survey; Professor Davidson has finished his work on astronomical latitude observations at Portland, Ore., and is about to return to San Francisco; Assistants Lawson and Dickens are at work near Los Angeles, while Assistant Rogers has finished the work of resurveying on the Straits of Karquines, at the mouth

of the Sacramento River, and is now making a resurvey in the vicinity of Golden Gate; various acting assistants in the coast and geodetic survey are preparing to take the field the first of June, to continue the work of furnishing points and data to different state surveys, Professor Buchanan going to Tennessee, Professor Campbell to Indiana, Professors Barnard and Merriman to Pennsylvania. Chart No. 2, from the mouth of St. John's River to Jacksonville, Fla., embracing the latest hydrographic work, and the improvements of the jetties at the mouth of St. John's, is now ready for distribution to agents.

— At a meeting of the Royal geographical society on May 11, a paper was read by Prof. W. M. Ramsay on 'Roman roads and English railways in Anatolia.' Before the reading of the paper, the chairman announced that royal medals had been awarded to Major A. W. Greely, commander of the U. S. Arctic expedition of 1881-84, for having so considerably added to our knowledge of the shores of the Polar Sea and the interior of Grinnell Land, and for the narrative of the expedition which he has just given to the world; and to Signor Guido Cora, for his important services as a writer and cartographer in advancing geographical knowledge, promoting the study of geography, and defining its position as a science. Professor Ramsay's paper detailed the results of his researches into the system of Roman roads in Anatolia, and the conclusions to be drawn from those researches as to the considerations which influenced the Romans in the formation of those roads.

— Another comet in Virgo was discovered Saturday morning, May 22, by Mr. Brooks. As determined by Professor Swift at the Warner observatory at ten o'clock Sunday evening, its position was, right ascension, 11h 51m 15s; declination, north 8° 55' 15". It has a slow motion south-east. It is very large, but faint. This discovery secures to Mr. Brooks the three first Warner prizes of the year.

— Commodore George E. Belknap has been detached from duty as superintendent of the naval observatory at Washington, and ordered to command the Mare Island navy-yard, California, about the middle of June. Lieutenant Bowman and Ensign Taylor have also been detached from the observatory. Commodore Belknap's successor has not been announced.

— The executive committee of the International institute of statistics met at Cologne on May 1, 2, 3, and 4. The members present were Sir Rawson W. Rawson (England), president; M. Levasseur (France), Herr Hofrath Neumann-Spallart (Austria), M. L. Bodio (Italy), and Mr. John B. Martin (Eng-

land). It was decided that the meeting of the institute this year should be held at Rome, from Sept. 23 to Sept. 29. The programme was drawn up, and a list of subjects to be discussed adopted.

LETTERS TO THE EDITOR.

Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

A new museum pest.

IN a collection arranged to illustrate a course in paleontology at the Museum of comparative zoölogy, a new set of labels was introduced last year, which has since been very much injured by the attacks of an insect, *Lepisma domestica*, — the silver-fish, in popular language. The labels are similar in plan to those which are used in the paleontological department of the national museum. They are made of thick paper, heavily sized with starch, with headings, and a border-line printed in black ink. They are bent at a right angle in the middle. The specimen is set on the lower half, while the description of the same is written on the upturned portion, rendering it visible without the necessity of lifting the specimen, — a distinct advantage, especially for class-room use. There are about seven hundred labels in use, and all, at the time of examination, had been written within ten months; yet not a single one had wholly escaped from the attacks of *Lepisma*. Many were eaten enough to obliterate the writing, and riddle the paper with holes; and all gradations between slight and extensive injury exist. Paper trays in which the specimens are kept, and which apparently contain no sizing, are not at all eaten. The labels are eaten on all parts except underneath, where pressed against the paper tray by weight of the specimen. The parts covered with printer's or writing ink are eaten quite as much as those which are not, contrary to the observations of others cited below. Careful search in the early winter led to the discovery of perhaps half a dozen specimens of *Lepisma*, but none have been seen since.

I have seen labels written on various kinds of paper, in the same and other departments of the museum, eaten by *Lepisma*; also a photograph, wall-paper probably, and an old engraving in New York. In this last the white portions were most affected, but some parts closely covered with printer's ink were eaten.

I have made many inquiries from naturalists and others, concerning the destruction done by *Lepisma*; but to most it was new. The late Prof. C. E. Hamlin of the museum said he had seen paper eaten, and titles eaten off the backs of books, where they had been attached by starch paste, but was confident that unsized paper was never affected. Prof. R. P. Whitfield of the American museum said that he had known injuries to labels to have been committed by *Lepisma*. Prof. F. W. Putnam, of the Museum of archeology and ethnology, showed me many labels which had been eaten, or entirely reduced to powder, by *Lepisma*. Mr. S. Henshaw, of the Boston society of natural history museum, had known of injuries, and, enclosing *Lepisma* in a jar with paper, found that the insects eat large holes in it.

It is clear that *Lepisma*, if not a very common visitant to museums, is at least a dangerous one when it does appear, and it behooves naturalists to be on the lookout for it. Labels, of course, are a most essentially important thing, and it seems not

overcautious to say that some means should be taken to prevent their being destroyed by insect foes.

If labels should be dipped in an alcoholic solution of corrosive sublimate, it would doubtless render them perfectly safe from the attacks of *Lepisma*, and other insects as well. In poisoning dried plants to prevent the attack of insects, botanists use a solution of the strength of one ounce of corrosive sublimate to a quart of alcohol. The same, or a solution of double strength, would seem advisable for labels. If, after dipping, they are dried between sheets of blotting-paper under a weight, or in a letter-press, the labels will not curl, or be injured in any way. Corrosive sublimate, under the conditions of a cabinet, is a perfectly stable compound, and would retain its protecting-qualities for all time; whereas most insecticides have to be renewed occasionally, and would render themselves objectionable in one way or another by their presence. Labels may be treated with great rapidity if a large number are done at one time. Those already written on may be poisoned without affecting the ink; at least, such has been my experience.

Paper sized with lead might be proof against insects; and I have not seen any injuries done to labels sized with rosin, though a large number were in the cases where *Lepisma* committed its ravages.

Labels, after being written, could be coated over with water-glass (silicate of soda), which forms a hard, transparent glaze, and would surely be proof against insects; but it is objectionable, in that it takes a good deal of time to brush over each label after writing it, and, besides, the label curls somewhat in drying.

Professor Hagen has been told by ladies that their silk dresses, always black ones, had been destroyed by carpet-bugs, and has answered that they only attack wool, and has only lately learned that *Lepisma* did the damage. He also says that gold lettering on the backs of books, which is commonly done by putting gold on paste and burning it in, has been undermined by *Lepisma*.

When I first showed the labels to Prof. H. A. Hagen, seeking his advice, he was much puzzled, as he thought *Lepisma* could not have eaten them, and *Anobium*, the great library pest, does not like starch; in fact, he says it has been recommended to use such paste as is made of pure starch, in binding books, to avoid the latter.

Professor Hagen was much interested in this pest, new as such to him, and, looking up the literature of the subject, read a paper on it before the 'Thursday club.' Part of his delightful paper was published in the *Boston evening transcript* of March 13.

He very kindly wished me to write an account of what I had observed in regard to *Lepisma*, and to add from his manuscript the facts which he has gathered: they are contained in abstract in the following:—

Lepisma destructive to the labels is a true American insect, described by Professor Packard as *L. domestica*. There are half a dozen species in the United States. The principal one in Europe is *L. saccharina*, the small blue silver-fish. This insect is found in dark corners, and near provisions. In Europe it has always, but without proof, been considered as imported from America. It has been known there for over two hundred years; but its existence cannot be traced before the discovery of America. The whole of its flexible body is covered

with fine iridescent scales which have been used as delicate microscopical tests; and to these hairs it owes its common name of silver-fish.

Nearly six years ago, at a meeting of librarians in Boston, Professor Hagen read a paper on library pests. After a review of the literature then at command, he concluded that only two North American insects were to be considered very dangerous to books,—the white ant; and *Anobium*, a small beetle which is also injurious to old furniture. These additions to his communication have been published; but they contain only isolated cases, certainly nothing of general importance.

The earliest notice of the small European species is in R. Hooker's 'Micrographia,' a folio published in London in 1665, and containing an account of innumerable things examined under the microscope. It is still respected for the accuracy of the author's statements. He figures *Lepisma*, and calls it book-worm, and says it corrodes and eats holes in the leaves and covers of books. On Mr. Hooker's authority, *Lepisma* was reported as injuring books; but as Mr. Hooker apparently confounded destruction done by *Anobium* with that of *Lepisma*, and since during the next hundred years no damages due to the latter were observed, the observation was doubted; and Professor Herman of Strasburg, in his prize essay on library pests, declared, in 1774, that *Lepisma* was erroneously recorded as injurious to books. For this reason, Professor Hagen did not mention *Lepisma* in his communication on library pests; the more so, as again in the next hundred years no new observations had been recorded.

Soon after his communication, new proofs of the depredations of *Lepisma* were observed. Professor Westwood of Oxford showed at the Naturalists' association in 1879 a framed and glazed print, in which the plain paper was eaten, while the parts covered with printing-ink were untouched. He mentioned that the same fact had been observed in India, where government records had been injured in a similar way. Patrick Brown says, in his 'Natural history of Jamaica,' that *L. saccharina* is very common there, and extremely destructive to books and woollen clothing. This statement was reproduced by Linnaeus, but was later considered as unreliable. M. de Rossi writes, in 1884, that *L. saccharina* likes damp places. It destroyed paper-hangings in his house, muslin curtains were perforated, and living animals found near the holes; also insect-boxes, and wings of butterflies, have been damaged. Professor Liversidge, in Sydney, reports the same year that *L. saccharina* is very common in New South Wales. He says it does not do much harm to books, as it cannot get in between the leaves, but injured loose papers, maps, and labels. The loose edges of piles or bundles of letters suffered more than the interior. The same calamity is reported by Mr. H. Lucas, assistant in the museum of the Jardin des Plantes in Paris. He says *L. saccharina* destroys labels of white paper, but parts printed on with minium and oil remained untouched. Labels of starched paper were much injured, but only the white parts. When leaving the country in 1862, he put in a drawer various articles of starched clothing, and, returning after six weeks, found numerous holes in it, and *Lepisma* near by. Dr. Aube, in Paris, says that the black part of the backs of books has been nearly destroyed, probably by *Lepisma*. The well-known antiquary, Mr. Quaritch of London,

complained in 1870 of injuries done to books by *Lepisma*; and Mr. Lewis, after careful examination, stated, that, on account of parts of the bindings having been eaten, the books fell to pieces. He considered it impossible for *Lepisma* to bore holes in the books, which holes were probably made by *Anobium*. Mr. Morrill, head master of the Boston Latin school, has sent books at different times to Professor Hagen, which were injured by *Lepisma*, and specimens of the obnoxious insect as well. Professor Packard, in his guide, speaks of silk being eaten by *Lepisma*, which also devours paste, making holes in the leaves of books. Also Mr. Horne of London alluded to the damage done to silk garments in India by *Lepisma*. The insect doubtless attacks the silk for the stiffening-matter in it, but nevertheless destroys the fabric. Finally Mr. Adkin showed a species of *Lepisma* which damaged account-books kept in an iron safe in London.

After all these reliable facts, there is no doubt that *Lepisma* may become very destructive to maps, engravings, photographs, herbariums, and other things, if left undisturbed. The question, why has it not been observed long ago? may be answered by the fact that they run so swiftly that they are easily overlooked.

If we tabulate all the facts, we find directly that all damages, excepting to paper, have been inflicted on clothing, muslin curtains, etc., which were invariably starched, or finished with some stiffening size. I found a set of labels in the museum which had apparently been eaten by *Lepisma*, but which, on most careful tests being made, proved to contain no starch.

Lepisma is easily destroyed by insect-powder, which kills all that it reaches; and Professor Hagen recommends the same to be sprinkled about silk dresses, or the drawers and closets where such articles, or others likely to be attacked by *Lepisma*, are kept. He would cover the backs of valuable framed engravings with common, unsized paper, fastened with a paste mixed with insect-powder. All papers, where pressed closely together, are not reached by *Lepisma*, and in this way large numbers of accidents may be avoided; or, if they would be injured by pressure, they will be safe kept in simple pasteboard boxes, made to close perfectly, so that the little pest could not find an entrance.

ROBERT T. JACKSON.

[This obliteration of labels by insects, presumably by species of *Lepisma*, has long been a source of annoyance in the paleontological department of the Yale college museum. To remedy the evil, the labels have been, for some time past, prepared by soaking in a solution of corrosive sublimate or arseniate of potash.—ED.]

Evolution and the faith.

It seems almost a pity that a magazine with the splendid reputation that the *Century* possesses for the encouragement it has given in past years to our contemporaneous expounders of modern thought, should admit to its columns such a contribution as the one that appears in the May number, from Mr. T. T. Munger, bearing the above title.

Mr. Munger closes the essay in question by indicating "in a categorical way the lines upon which further study should be pursued" with respect to evolution.

The several lines laid down in this category are divided into two sections, which are, 1°, "the respects in which evolution, as a necessary process in natural and brute worlds, does not wholly apply to man;" and, 2°, the "contrasting phenomena of evolution under necessity, and evolution under freedom." The first section indicates ten lines for further research into the laws involved; and the second, six. It would occupy far too much space here to reproduce all of these in the words of our author; and especially is this unnecessary, as it is my sole object to endeavor to show the general fallacy that pervades them all.

It must be evident to every one of us that Mr. Munger's chief error lies in the fact, that, in drawing up these 'further lines for research,' he has kept only before his eyes an idealized man and an idealized brute. May I ask our author where that hard and fast line is to be drawn, where 'instinct yields to conscious intelligence'?

A good many years ago I availed myself of the opportunity extended to me on a number of occasions, to examine that mass of living humans which constituted a cargo that filled the hold of a slave ship in the West Indies; and many a time since have I had the privilege of studying some of the lowest types of the now-existing Indians in this country. If Mr. Munger has ever had the opportunities of observing the habits of such creatures in their native haunts, I doubt very much that he would be wholly prepared to say, that, among *all species of men*, "the struggle for existence [now] yields to a moral law of preservation, and is so reversed."

Are our researches to now cease with respect to these low types of brute-like men, of which whole races still inhabit various quarters of the globe? Take the Mojaves of this country, and some of the tribes of central Africa, or Asia, or the native Australians, and any number of examples from them will stand witness to violate nearly every axiom Mr. Munger lays down in his category in the *Century*. In reality, some of them fully carry out the popular notion of a 'connecting link;' and from a study of their physical and moral organizations, science, no doubt, has derived some of her most trustworthy data for the establishment of evolutionary laws. They have by no means 'become conscious of the Infinite One,' nor do they 'systematize knowledge and reason upon it;' or at least, as Mr. Munger says for the brute, 'except in a rudimentary and forecasting way.'

Perhaps the remaining 'lines for research' of our author's category, upon which I have no comment to pass, may be more pertinent to a far later stage of man's development than would hold good at this day. The laws of evolution are still in active operation about us on every hand, and they have by no means been suspended in man's case, as Mr. Munger would have us believe. It can be said of the highest and best types of men, that, as a class, they are but on the threshold of psychical and intellectual evolution, while some of the lowest forms of the black men of Africa occupy a moral and mental plane but a few degrees above the one in which we find the corresponding attributes of some of those representatives of the animal kingdom that no doubt, in our author's zoölogy, would be classified among the brutes.

R. W. SHUFELDT.

Fort Wingate, N. Mex., May 18.

Errata.

In these days of co-operative enterprises there is a chance of success for many a useful scheme that in other times would be utopian; and so the writer would like to suggest the usefulness of a separate systematic publication devoted to errata, to appear at intervals as materials accumulated for it. In it any student of an important book might hope to find collected all the important errors that critics and other readers had discovered. These errors might be disturbing misprints, slips in dates or the spelling of a name, mistakes in formulae or mathematical tables, etc., or possibly might extend to very brief criticisms on a book for the omission of very important facts bearing on the argument, or the use of unreliable authorities. Just how far it would be safe or desirable to go into such criticism, must, of course, be left to the judgment of the editor.

If such a plan commends itself to those who use books, and therefore want them to be correct, it ought not to be difficult to put it into operation through the co-operative work of public-spirited publishers, and of the librarians, who have already done so much for book-users, that in our gratitude to them we have the proverbial 'lively sense of favors to come.'

If the publication of such a list as this were started, either as an independent venture or as a supplement to the *Publishers' weekly* or the *Library journal*, we cannot doubt that many readers all over the country would gladly furnish contributions to it; and such scattered corrections as one finds in newspaper reviews of a book would be collected in a way to be useful to all who use the book in question.

C. K. WEAD.

Popular astronomy.

Permit me to make a few remarks on the review of my 'Story of the heavens,' which appeared in your issue of April 23.

You first charge me with appropriating a figure on p. 78 of Professor Newcomb's 'Popular astronomy,' and you assert that the text relating thereto has been borrowed from him. I refer to my 'London science class-book of astronomy,' articles 60 to 63, where essentially the same figures and reasoning are used. This was published in 1877; Newcomb's, in 1878. No doubt I had read Newcomb afterwards, and possibly improved on the original illustration by so doing. Probably the same idea has occurred to many others besides Newcomb and myself.

You also charge me with taking illustrations without acknowledgment, yet out of one hundred and six figures you only cite one (p. 228) to support the charge. The extent of my offence is just this: in the original manuscript of my book I had referred to Newcomb, but I struck out the reference from the proof in the belief that he would not care to be cited for so trivial a matter.

The two passages from Professor Young's 'Sun' have been unconsciously adopted by me by a carelessness which I sincerely regret. They were copied some years ago for use in my lectures; they passed into my manuscripts, and I lost sight of their origin, and treated them as my own language, which, until my attention was called to the matter by your review, I believed them to be.

While I am glad to have my errors pointed out, and to make what reparation may be possible, I must indignantly protest against the tone of your com-

ments. You have fastened the worst construction on these blots, and accuse me of pillage. The simplest principles of justice should have required you to hear my explanation before you make so serious an allegation. You have even spoken of it as wholesale pillage, with what justice I leave your readers to decide. I have added the lines in the passages impugned in your review, as well as in the kindred review in the *Nation*; I have also added the equivalent of the illustration on p. 228; and I find the whole amounts to two pages and a half, while the entire volume contains five hundred and fifty-one. ROBERT S. BALL.

Dublin, May 12.

[We are glad to publish Professor Ball's reply to the critics of his book, and hope that he will feel fully vindicated by the letters from Professors Newcomb and Young in *Science* of April 30. — ED.]

Barometer exposure.

You gave a place to my letter showing how thermometers were affected by the place of exposure: will you now allow me to point out how the barometer also seems to be thus affected?

At the Blue Hill observatory, during high winds, the barograph shows sudden small oscillations, which, on watching, have been found to be coincident with changes in the wind's velocity. When the wind rushes by with increased velocity, the barograph sinks; and when the wind subsides somewhat, the barograph rises again slightly. About noon on March 16 the wind's velocity rapidly rose from five to thirty-five miles, and the barometer suddenly fell five-hundredths of an inch. During a sudden gust attending a shower last summer, the barometer fell a tenth of an inch, and immediately rose again as the gust ended. These facts all suggest that the wind, in blowing by at right angles to the cracks and crevices in the building, produces a mechanical effect, which tends to draw the air out of the building, and decrease the pressure inside. In confirmation of this conclusion, whenever, during high winds, the hatchway in the top of the tower is opened, it gives a larger aperture for the wind to act on, and the pressure on the inside immediately falls. It fell as much as a tenth of an inch during a seventy-mile wind in February. This seems to point to the conclusion that during high winds the barometer reads too low.

In Loomis's fifteenth paper in the *American journal of arts and sciences*, he discusses the reduction to sea-level of the barometer-readings on Mount Washington, and finds a number of cases in which the barometer-readings, when reduced to sea-level by the formulas usually in use, are three-tenths of an inch or more lower than would seem to be the true readings as determined from the neighboring stations of Burlington and Portland. These cases all occurred when the wind was very high on Mount Washington, the average being sixty-six miles per hour, and some cases showing as much as a hundred miles. In his remarks, Loomis says that these "great anomalies are confined to the colder months of the year, and seldom occur except during the progress of violent storms."

This suggests that at Mount Washington, as at Blue Hill, and probably elsewhere, the wind, in blowing by the building with great velocities, produces a partial vacuum inside.

H. HELM CLAYTON.

Blue Hill observatory, May 18.

SCIENCE.—SUPPLEMENT.

FRIDAY, MAY 28, 1886.

THE STATE AS AN ECONOMIC FACTOR.

I.

THERE is no more significant difference between what, for lack of better terms, we may call the old and the new schools of political economy than their respective attitudes toward the state. The old school, in which I would include Adam Smith and his best-known English followers, culminating in the so-called orthodox economists, derived their ideas in regard to the nature and functions of the state from the views of the writers on jural and political science which prevailed in the latter half of the last century. They have almost universally accepted these conceptions of the state as fully satisfactory for the uses of the economist, without any real attempt at an analysis of the functions of the state from the economic side. It is hardly necessary to say that these ideas have long since been repudiated by the cultivators of the jural and politico-philosophical sciences as entirely unsatisfactory. But the orthodox economist has held to them as if they were law and gospel. We have, as a consequence, the rather absurd phenomenon of the cultivators of one science holding to the conceptions taken from another which the latter itself rejects as worthless for all scientific purposes.

The new school, on the contrary, has simply adapted itself to the changed conditions, and accepted the results of scientific progress in neighboring fields, and on this as a foundation has undertaken to carry the science another stage forward in its development. It has indeed contributed something to jural philosophy itself by its attempts to analyze the concept of the state from the economic side, in order to ascertain the function which it performs in the process of economic production and distribution.

Adam Smith, in common with the tendencies of his time in the field of political and jural speculation, looked upon the state as a purely negative factor in economic and social life, — a something which grew out of the defects of men, — a necessary evil which did most good when it did least harm. He considered its functions to be simply those of protecting society against aggression from without, and violence within. He saw in individual action the source of all progress, the

hope of all civilization, and held that the race would move forward in proportion as all government trammels were removed from individual activity. I do not mean to say, of course, that Smith was consistent in this view, because consistency in such a view is simply impossible, and has never been achieved by any great thinker. He was compelled to disregard his theory repeatedly when discussing practical questions of government and politics of his own time, and many passages may be quoted from his works to prove that he tacitly repudiated the whole doctrine. In this respect he resembles very much some of his distinguished followers, who, finding it impossible to be consistent and to bring their theories into harmony with the hard facts of the actual world about them, make all manner of practical concessions inconsistent with their fundamental principle, which may be quoted to prove that they did not hold such doctrines at all.

But no one can read Smith carefully without admitting that his theory of the state practically denies to the latter any economic function whatever, beyond the simple one of keeping order within its boundaries. All that is more than this cometh of and leadeth to evil. Certain it is that all those in this century who have been opposed to state action of any kind have appealed to the authority of Smith and certain of his followers as having established beyond a doubt that the state has no business to interfere with economic or social relations.

As a matter of fact, Smith made successful war upon certain forms of governmental interference, which in his time were undoubtedly doing great harm; but instead of being content with showing that those particular restrictions had outlived their usefulness, and that the time had come when they could be better dispensed with, he tried to show, or rather assumed, that such restrictions were *per se* injurious, and could be productive of evil only.

The investigation of historians in this century has proven conclusively that the state, so far from being the source of innumerable evils, has always been not only the absolutely essential condition of human progress, but also one of the most important, if not, indeed, the most important, factor in the economic evolution of society itself. It proved that no economic progress has ever taken place outside of the state, and very little indeed within it, except on the basis of the active sup-

port and co-operation of the latter. It established the fact that in state initiative, indeed, lay oftentimes the only hope of any economic development. It demonstrated that many of the very institutions which Adam Smith and his followers so vigorously and successfully assailed had in their own time done the most valuable service in initiating and furthering economic progress. In a word, it dealt a death-blow to that conception of the nature and origin of the state which played so large a rôle in the political speculations of English, French, and German philosophers of the last century by showing conclusively that nothing corresponding to their premises had ever actually existed in human history, and that state action, not merely of a restraining but also of a fostering and furthering kind, has always been the condition and concomitant of any considerable economic development.

The conclusions of history, sufficient of themselves to destroy the old theory, are amply sustained by a careful analysis of the process of production and distribution in our modern society. If we analyze any of the most ordinary acts of production, we shall find that the state is actually or potentially present at every stage of the process. Take, for example, the business of making cloth. The manufacturer could not hope to make any considerable amount of cloth if the state did not protect him in his work by the force of its courts and armies. He could make but a very small quantity, indeed, without the aid of inventions, the preservation and transmittance of which, nay, their very existence itself, is only possible within and through and by the state. Having produced his cloth, he would have no right worth the name to its ownership, if the state did not define and enforce his rights as against all other parties within the state. Having produced it, and being acknowledged as the owner of it, it would be of no earthly value to him, except so much as he might wish to make use of for his own personal purposes, if the state did not protect him in his right to exchange it for the product of other labor toward which the state stands in exactly the same relation as it bears toward that which he produced. The value of his product depends almost entirely upon the means which the state has provided, in the form of roads and means of transportation and communication, to enable him to get to a place where he can exchange it. The value, moreover, depends largely on the general state of civilization within the country, which is to a very great extent determined by state activity. The enjoyments which he can extract from the products he may receive in exchange for his cloth will depend to a great extent on the education which he may

have enjoyed, which, again, will be determined by the extent to which the state may have provided the necessary facilities. When we look, not merely at an individual act of production, but take in a wider view of the industry of the country as a whole, we shall see still more clearly the real character of the state as an economic factor. We see, for instance, in manufacturing, that the discovery and introduction of improvements, the provision of means of transportation, the general provision of educational facilities, both technical and general, — all necessary elements in any wide and long-continued successful system of industry, — have been nearly always chiefly furthered and promoted by state activity in some form or other. In other words, every great extension of the field of production has really been to a large degree dependent on state interference — not merely in a restraining, but also in a promoting and fostering way.

We may formulate our conclusion, then, somewhat as follows: the state is an economic factor of prime importance. To our modern system of production not only are natural agents, labor, and capital necessary, but also the particular kind of services which can be rendered only by the state. The nature of its service is just as fundamental to production as that of labor or capital, and it should be included among the requisites of production. It is a fundamental economic category, something which belongs to the very essence of production, and not something accidental and external, which may be lightly cast aside.

The particular function of the state in the sphere of economics is a varying one. It changes with time and place and circumstance. Perhaps the most general formulation of the essential characteristic of state action in this field is that it is pre-eminently a co-ordinating power. It is a special form of associative action. History shows that men as individuals do not live unto themselves. They must carry on the struggle for existence side by side within and through some kind of social organization, if they are to attain any higher level than the brutes. But no sooner do they appear within such an organization, than the absolute necessity of some type of co-ordinating power immediately appears. Individuals may and ordinarily do appropriate natural agents, and insist on utilizing them in such a way as to preclude any great economic advance; as, for instance, when men take possession of large tracts of land, and refuse to allow others to pass through them. In such a case, the necessity of a co-ordinating power immediately appears. The state, or what answers for that in the given condition of society, must open up roads, no matter what individuals may wish, if

economic development is even to begin. The lay of the land may be such that an extensive system of drainage may be indispensable in order to render it fit for cultivation. The whim or interest of individuals may, and where they are allowed free play usually do, prevent the inauguration and completion of any such work. Associative action may be, and ordinarily is, the only means of securing such an end. Voluntary associative action is generally precluded by the refusal of some individuals to take part whose co-operation is necessary to success. The only means left is compulsory associative action through and by the state. The time soon comes in a progressive society when, in order to secure a higher degree of efficiency, new crops, new kinds of live-stock, new inventions, are necessary; when a new organization of the labor of the country must be undertaken, as, for instance, the abolition of slavery or serfdom, or the development of a system of small farms, — all things which are just as necessary to an increased production as the application of more labor and capital, and all things which can be accomplished on a great scale only by the exercise of state power. Furthermore, a time comes when, in order to secure a larger production, the great mass of the people must be educated, and the skilled laborers necessary to the economic progress of a society must have facilities for acquiring a technical education. All recent history shows that the state must here interfere, and compel co-operative action on the part of its citizens, if the necessary facilities are to be obtained. To take another example, science and experience demonstrate, that in order to obtain the maximum of agricultural production, for instance, from a given country, it is necessary that a certain portion of the surface should be wooded. History shows us that there is no adequate economic motive for private individuals to preserve this proportion if it has once been established, or to establish it if it has never existed: hence the necessity for the state to interfere, and to secure by the application of compulsion the necessary conditions of progress. An excellent instance of this same thing is to be found in our modern railroad system. In order to secure the building and equipment of the railway, we have had to pay enormous sums, directly and indirectly, from the common treasury of society. The state, in all its various governmental forms, national and local, has contributed land, money, and legal powers and guaranties, without which our railways would have remained a comparatively insignificant element in our system of transportation. It has created fictitious persons for the ownership and management of the railways. It has given those

fictitious persons not only immense sums of capital, but peculiar and ample privileges; among others that far-reaching and most significant attribution of sovereignty, — the right to take the property of real persons against their will, and give them, not what the owners consider it worth, but what it seems worth to parties who look upon it in the character of disinterested appraisers.

To sum up this phase of the subject in a few words: a community, on emerging from barbarism, and as it passes from one stage of civilization to another, finds, that, in order to secure a healthy economic progress, large quantities of capital and labor must be expended along lines where a few individuals, by their ignorance or obstinacy, may prevent that collective action without which such investment cannot be made. It is necessary for the state to interfere in such cases; and its action is as truly economic action as that which removes by a tunnel the obstruction presented to trade by a hill, or which renders commerce across a river easy by the construction of a bridge. This same community finds, moreover, that large quantities of capital and labor must be expended along lines where private individuals cannot be persuaded to invest it, since they can see no immediate and sufficient return to them personally. The state is in such cases the only hope; and if, by its incompleteness or weakness, it is unable to respond to this demand, progress stops and retrogression begins.

It is easy to see the bearing of this general view of the economic functions of the state. It establishes the primary importance of state action in economic progress, and it claims for it a purely economic character. So far from allowing that the presumption is always in favor of non-interference on the part of the state in economic matters, it claims that in whole classes of economic processes the presumption is strongly in favor of government interference; so strongly, indeed, that the mere fact of government non-interference proves that the community is living in a lower economic stage than is within the grasp of its collective action by state agencies. It vindicates for the collective action of the community, within and through and by the state, an economic function no whit less fundamental, no whit less important, and in many respects more far-reaching, than that hitherto accorded to individual action. It is an idle attempt to decide which is the more important of two factors both of which are absolutely necessary to the result. It is like trying to prove, that, of the two lines which form an angle, one is more necessary than the other. And yet this is what the old school attempted to do in belittling the economic

functions of the state. The new school simply desires to claim for them their proper position. It is undoubtedly true that in certain countries individual activity and initiative are not vigorous enough to work out the highest possible economic results; but it is also equally true, that, in other countries, state activity and initiative are not vigorous enough to secure the economic results which can only flow from collective action within and through and by the state.

The relation of this theory to the subject of taxation, for example, is significant. From this point of view, taxes are not rewards paid by the individual to government for the protection accorded by the latter. They are simply a share of the product which the state may rightfully claim as being one of the factors in the process of production. The state, as the representative of society, is the great 'silent partner' in every business enterprise. As compared with any given individual, it contributes the larger share of the means of production. To test the relative productivity of the state and the individual, compare the fortune accumulated by Cornelius Vanderbilt in America with what he might have accumulated had he been adopted when an infant by a family of Hottentots.

One word more as to the bearing of this theory on the future of the state as an economic factor. According to the old theory, the functions of the state will become fewer and fewer as society progresses, until finally it will do nothing, or at least nothing but protect, in the narrowest sense, life and property. According to the newer theory, as men become more numerous, the conditions of society more complicated, the solidarity of interests more complete, we shall find that the economic sphere of collective action as opposed to individual action is all the time widening. Hand in hand with this advance, we shall find that government will be so improved that the state can safely undertake to a larger and larger extent the exercise of this collective action. So far, then, from the interference of government decreasing with the improvement of men, we shall find that this very improvement renders it safe and desirable to increase the sphere of state activity. All this can be done without in any degree impairing individual activity of a desirable kind, and, indeed, with the result that the sphere of the latter may be continually widened.

To put the case in a little different way, there are, according to this view, in any given state of civilized society, certain classes of economic actions which can be best performed by a general system of co-operation embracing all the members of said society. To the efficiency of certain of

these classes it is necessary to have complete co-operation, which, as all experience proves, is only possible through compulsion. The only form of desirable compulsion in such cases is state compulsion, which, of course, may be exercised in various ways—from compelling co-operation by courts and armies, to that of undertaking the business by government agencies. If such actions are left to private individuals, it just as surely results in economic injury to society, in circumscribing the field of employment, in discouraging and destroying individual enterprise in the widest and broadest view, as the assumption by the state of forms of economic activity, which should be left to private individuals, tends to destroy all spirit of enterprise in a body politic. When it appears, therefore, on analysis of a given case, that it is one which calls for compulsory collective action, it is not a satisfactory answer to say that the government is too defective in its organization to undertake such work, and therefore it must be left to individuals, since this simply means that it will not be done at all. For certain economic ends the only efficient agency is state agency; and, if that is not available, the only result can be failure to reach those ends. In case of defective government, then, our course is not to rest content with remanding government functions to private individuals, but to improve government until it is adequate to the legitimate demands; and one of the most effective means of improving government is to insist that it shall undertake its proper functions, since the consequent importance of its work will render imperative its re-organization on a proper basis.

E. J. JAMES.

II.

1. Professor James says much of the old school and the new school of political economy. Yet the differences between the schools, so far as he mentions them, are not on strictly economic matters. He discusses the nature and function of the state, and raises very wide and difficult questions. These questions economic science does not answer and should not pretend to answer. It merely helps to answer them, by investigating one aspect of man's activity. Economists have often expressed themselves on the general subject of the sphere of government; but in so doing they have spoken, not as economists, but as speculators on the theory of the state and of society at large. Adam Smith no doubt said a good deal about the proper limits of government action. Yet his conclusions on that subject formed no essential part of his economic doctrines. So, in the first half of this century the followers of Ricardo frequently gave

expression to a certain conception of the state, which is indicated by the phrase *laissez faire*. They sometimes went so far as to treat *laissez faire* as a natural law, nay, as a natural law of political economy. It was a great mistake to treat it as a natural law; at most, the phrase indicates only a rough rule of thumb. It was a still greater mistake to treat it as a law of political economy. Political economy investigates and explains the phenomena of wealth; in doing so, it helps the 'jural and politico-philosophical' thinker (to use Professor James's comprehensive expression) in solving his general problem as to what the state should do. But economic science does not pretend to solve it, by laying down a rule of *laissez faire* or one of state interference. In laying down a rule as to state interference, the new school is not a new school of political economy, but a new school as to something else. Its adherents commit the same mistake, as it seems to me, that was committed in former days by the adherents of the *laissez faire* ideas, whom they attack so sharply. They fail to distinguish between the province of economic science, and that of sociology, or social science, or political science, or whatever the general science be called.

2. No economist has denied that the state is a most important factor in industrial matters. The economist says, given such and such a condition of the laws and of the government, what effect on the phenomena of wealth can be traced? Obviously the character of the government, and the extent to which it maintains peace and order, enforces contracts, and protects property, are of the utmost economic importance. Professor James's lucid exposition of the cloth-manufacturer's situation is hardly needed to prove this. But thereby he does not succeed in showing that the government should become a still more important factor, or a factor of an essentially different kind. Possibly it should; but to establish this, it is not a valid argument to adduce the unquestioned fact that the activity of the state is at present one important cause among a large number that bring about economic phenomena. In the eighteenth century, government interfered multifariously and vexatiously in industrial matters; yet surely that fact in itself did not go to prove that it should interfere still more.

3. It is a very sweeping statement that "every great extension of the field of production has been to a large degree dependent on state interference, not merely in a restraining but in a fostering and promoting way." That raises a question of fact, of economic history, on which I must beg to differ with Professor James. His statement seems to me exaggerated, and in essentials incorrect. The eco-

nomic history of the last hundred and fifty years does not support it. The enormous advance in the arts during the past century seems to me to have been singularly independent of state interference. Certainly it has not been the result of any extension of government activity over and above that degree of activity which was common in the preceding period. The state tried to foster and promote in the seventeenth and eighteenth centuries much more than it has done in our time; yet we have seen a striking enlargement of the field of production. If economists of the old school belittled the importance of the state, those of the new school are in danger of succumbing to a temptation to exaggerate it.

4. As to the main question, namely, the attitude we should take to the question of state interference in industry, Professor James states his belief that the presumption is strongly in favor of interference 'in whole classes of economic processes.' It is not clear to me how much he includes in this phrase. No doubt there is a tendency toward a degree of regulation in some branches of industry, of which railroads and telegraphs are prominent examples. Economic study gives certain data on such questions; for instance, by showing the advantages of single management, and the supplanting of competition by combination. The data given by economic study, together with those given by study from other points of view, lead us to believe that, as matters stand now, the community should regulate these industries more than it does cotton-spinning and bread-making. How far it should go in its interference is a practical question, to be settled for each case slowly, cautiously, tentatively. In comparatively simple cases, like water-supply, complete ownership by the public has come to be the general rule. The time has perhaps come to handle gas-supply in the same way. How far we will go or should go in a complicated problem like that of railroads, no man can tell. Certainly it is premature to lay down a general rule or presumption in favor of state ownership or management. That new theory which tries to lay down as some sort of a law, or at all events as a certainty for the future, a steady and continued enlargement of the sphere of state activity, rests as yet on a very slender basis of experience. In any case, it is not a new economic theory, but a wide speculation in sociology.

Very little seems to me to be gained by advancing, for problems of this kind, general speculations about collective action and the sphere of the state. Certainly there is no occasion in this country to stimulate the tendency in favor of state interference. There is already quite a sufficient general inclination to interfere. Not infre-

quently, to be sure, one hears expressions about natural freedom and non-interference with the natural laws of trade; expressions which are survivals of the exaggerated *laissez faire* tinge of a generation ago. But no feeling of this kind operates as an effectual barrier to state interference, or stands in the way of needed reforms. On the contrary, public men and voters alike are over-ready to jump at schemes for state regulation, and to engage in crude and harmful and impracticable legislation. Witness the passage in the house of representatives of a bill like the Reagan interstate-commerce bill, — fortunately replaced in the senate by the more moderate, though still far-reaching, bill just passed by that body. In face of the rash attempts of which the Reagan bill is a type, economists and students can most usefully approach the problems, not by general encouragement of state regulation, but by the careful and unbiassed study of specific questions.

F. W. TAUSSIG.

III.

IN his criticism of my views, Professor Taussig takes the old ground that economic science has nothing to do with the functions of the state. This is exactly the point at issue, and could not, perhaps, be better put than it is by Professor Taussig. I hold that the science of political economy must consider the *economic* functions (notice the limitation) of the state in order to afford any satisfactory explanation of the phenomena of wealth in modern society. It would undoubtedly be possible to construct a science of an economy in which capital, for example, played only an insignificant part; but such a science would have no sort of relation to modern, social, or political life. A science of wealth which leaves out of its treatment the economic functions of that co-ordinating power which in its highest form we call the state, is almost as far removed from any vital connection with our present or future needs.

This is undoubtedly the real reason why all the great thinkers in the field of economics have as a matter of fact, in spite of their protestations that it had nothing to do with the subject, given such a large share of attention to the functions of the state. Adam Smith's views of state action are not an unessential feature of his economic theories. They form part and parcel of them, and cannot be extracted without shaking to its foundations the edifice into which they are built as constituent parts.

The scientific advantage of the view for which I am contending, over that represented by Professor Taussig, consists, as I conceive it, in this. If we recognize the fundamental economic char-

acter of state action, we have a simple, plain, scientific basis for examining the relations of state action to other forms of economic activity. It enables us to investigate within the limits of our economic system whole classes of economic facts connected with state action, which, however much we may wish to disregard them, will force themselves on our attention, and if not treated in an open and scientific manner, and assigned to their proper place, must be disposed of in a half surreptitious and unscientific way. This point of view enables us to bring state action, *so far as it is economic in its nature*, into organic relation with other economic forces in our scientific system, and by an analysis of the processes of production, distribution, and consumption of wealth, to assign to each factor that sphere of action which, with a due regard to existing economic conditions, shall work out the best economic result. This theory is, in my opinion, a progressive one. It contains the promise and potency of life.

The other, on the contrary, is the opposite of this in the respects just enumerated. And so far as any thinker maintains it, and is still doing progressive and active work in the field of economics, — and no better example of this class can be quoted than Professor Taussig himself, — he is continually, as it appears to me, violating his own fundamental principle, and working at a scientific disadvantage.

It will be noticed that this view in itself does not call for any extension or limitation of state action. It simply maintains that there is a sphere of economic activity in which state action is by far the best, if not the only, means of reaching satisfactory results. It holds that this state action is as truly economic as that of individuals, and that it should therefore be regarded as a fundamental economic category. The exact limits of this sphere — the exact things to be done by the state — vary with time and place and circumstance. It may therefore very well be, that two persons holding these different views might agree as to what state action, in an economic direction, is desirable, for instance, at this time in our own country. The difference, as it seems to me, would be simply that the views of the one in regard to state interference would form a consistent part of that one's general economic system, while those of the other would be more or less adventitious. It is the former class of views which promote the development of a science.

I desire, in closing, to express my dissent from Professor Taussig's opinion that the enormous advance in the arts during the past century has been singularly independent of state interference. To argue this point of difference would require a

long chapter of economic history. I think the statement on this point in the body of my article is essentially true. Nor can I agree with my critic that we do not need to stimulate the tendency in this country in favor of state interference. I think that we are prevented to-day from undertaking certain great reforms by the general feeling in the community at large that individual instead of state effort should be relied upon in all cases to secure economic advance. To present the conclusion of the matter in a word, it is perfectly possible, of course, for the state to interfere in such a way as to discourage and destroy industry. All of us agree to that. It is, on the other hand, we claim, perfectly possible for the state to interfere in such a way as to promote and create industry—nay, more: it must be continually interfering to do this, otherwise progress would stop and retrogression set in. Such action is economic in character, and the systematic investigation and discussion of it find their proper place in the science of economics.

E. J. JAMES.

CLIMATE AND COSMOLOGY.

No one should take up Mr. Croll's essays for light reading; not because his writing is not sufficiently clear and concise, but because the interaction of the many direct and indirect causes concerned in his physical theory of terrestrial climate requires so involved a conception that the reader must go slowly to possess himself of it fully. This is shown by Mr. Croll's frequent and just complaint that his critics fail to apprehend his points.

The essence of his argument is, that, during a time of great eccentricity of the earth's orbit, the hemisphere, having its winter in aphelion, will be subjected to glacial conditions as a result of the various physical processes then brought into play. Prominent among these is the diversion of the warm equatorial ocean-currents into the non-glaciated hemisphere by means of the increased velocity of the trade-winds in the glaciated hemisphere, and their extension well across the equator, on account of the then great difference between polar and equatorial temperatures on which they depend. For example: if our hemisphere be the cold one, it is supposed that the north-east trade would gain in strength, and extend south of the equator, so far as to carry all the equatorial currents into the southern hemisphere. "The warm water being thus wholly withdrawn from the northern hemisphere, its temperature sinks enormously, and snow begins to accumulate in temperate regions."

Discussions on climate and cosmology. By A. CROLL. New York, Appleton, 1886. 12°.

If this fundamental point be conceded, we may as well grant all that follows it; but it cannot be conceded for a moment. Our north-east trade will doubtless be strengthened, in winter at least; but so will the prevailing westerly winds of our temperate latitudes. Moreover, the heat equator, along which the trade-winds meet, will not migrate far south from the geographic equator, on a planet with as short a year, as moderately inclined an axis, and as large an equatorial water-surface, as ours—especially when the southern summer is moderated by coming in aphelion, and again, especially in the Atlantic, as long as the coast-line of Africa allows so much cool South Atlantic water to reach the central torrid zone, and as long as Cape San Roque stands in the way and turns so much of the equatorial current northward.

No sufficient reason, therefore, appears for granting the north-east trade strength and area enough at such a time to keep warm water out of the North Atlantic, summer and winter; and in this ocean, at least, the general eddy-circulation would be continued much in its present form, all the more because whatever aid is given by gravity to the wind-made currents is then intensified. The broad drift of waters that crosses the North Atlantic from our shores to Europe would then be accelerated by the stronger winter winds; it would then, as now, divide opposite Spain; and the northern branch on which the moderate temperature of north-western Europe so largely depends would then, as now, be supplied largely with water that had been warmed while crossing the equator. As long as this source of warmth prevails, a winter's snows in far aphelion cannot overreach the succeeding summer's melting in close perihelion, without the assistance of geographic or other changes which Mr. Croll deems unessential.

In view of such objections as this, it seems to me that Mr. Croll decidedly overstates the security of his position in saying that his theory contains 'no hypothetical elements.' The quantitative estimation of his causes is certainly often hypothetical. Until more is known, not only about winds and currents, but also about the behavior of the atmosphere towards radiant energy, and the part played by dust over the land (of which Mr. Croll takes practically no account) as well as by vapor over the ocean, there must naturally be much of hypothesis in the discussion of terrestrial temperatures.

Readers of Dr. Croll's work should examine also a *critique* by Woeikof in a recent number of the *American journal of science*.

W. M. DAVIS.

MANUAL TRAINING.

IN the wave of enthusiasm for manual training which is now passing over this land, it is very difficult to get together the results of experience, and still more difficult to determine whether the plans which work well in one place are adapted to another. Therefore every honest record of a working organization is to be welcomed. Even when the opinions of a writer are not accepted, his statement of facts should receive attention.

These remarks apply to the volume on manual training, which has lately been published from the pen of Charles H. Ham. The work has its practical, its historical, and its philosophical aspect. In the first hundred pages there is an elaborate account of the Chicago manual training school, which was founded in 1883 by the Commercial club, — an association of merchants, who, after a discussion of 'How to increase the supply of skilled labor,' pledged the sum of one hundred thousand dollars for the support of an industrial school. A large building has been constructed, and instruction is given in carpentry, wood-turning, founding, forging, and in the making of machinery. The various laboratories devoted to these purposes are described, but the experience of two years is, of course, too limited to be very significant. The general principles of the establishment seem to be in close accordance with the well-known views of Professor Runkle of Boston, and of Professor Woodward of St. Louis.

In reading this volume we have been impressed with this danger, — that, in giving emphasis to the value of manual training, the worth of mental training will be overlooked. James Russell Lowell, in a recent speech, wittily said that not only are those studies of value which make bread-winning easier, but also those which will make every morsel of bread taste the sweeter.

The author of the book before us declares at the beginning that it is a theory of the Chicago school, that "in the processes of education the idea should never be isolated from the object it represents." Indeed! Can this be so? Are 'abstractions' to have no rights which the school is bound to respect? How about the idea of number, of form, of quantity, of force? Probably the author did not see the bearing of his remark; but he repeats it in these words: "Separated from its object, the idea is unreal, a phantom." This is very different from the saying of Sir Humphry Davy, that there is nothing so prolific in abilities as abstractions. Believing as we do in the great importance of manual training, believing

that every living being will be happier if he can skilfully use his fingers in some useful art, we regret to see the advocates of dexterity defend their views by wrong arguments and defective logic.

THE Johns Hopkins university circular for May states that Professor Rodolfo Lanciani of Rome will give a course of lectures on Roman archeology during the next academic year. He has been for some years professor of archeology at the Roman university, and inspector of excavations for the city, and is also one of the leading members of the archeological commission of Rome, and of the Pontifical archeological society. Though still quite young, he is one of the first authorities on Roman archeology, and has followed with greater care than any other archeologist the important excavations that have laid bare, from 1871 to 1886, so considerable a part of the ancient city. In 1880 he published "*I comentarii di Frontino intorno le acque e gli aquedotti. Sylloge epigraphica aquaria*," a learned work crowned by the Academy of the Lincei. This is but a small part of a great work to which he has been devoting years of research, — a complete topography of the ancient city of Rome, critical and historical. Professor Lanciani has contributed important papers to the *Bull. della comm. archeologica*, to the *Notizie degli Scavi*, and other archeological periodicals, besides separate works, such as '*Iscrizioni dell'Anfiteatro Flavio*' (1880).

— The recent invention by Dr. J. O'Dwyer of New York, of a new method of treatment to take the place of the dreaded recourse to tracheotomy in diphtheria and membranous croup, bids fair to be of the greatest importance. His method does away with cutting-instruments entirely, and consists simply in the insertion of a tube of peculiar shape between the vocal cords, thus permitting the ingress of air into the trachea. The results already reached by this intubation treatment compare very favorably with those from tracheotomy, as regards the saving of life; and if, on extended trial, they are borne out, the invention will be ranked with the more important ones of the century, in medicine.

— Mr. S. Hertenstein of the Zoölogical museum of the Academy of sciences, St. Petersburg, Russia, is endeavoring to prepare schemes for public museums in Russia, to be promoted by the authorities. He would be grateful for any reports of American museums, especially such as relate to their organization rules or plan of operations. Any such may be mailed to him direct, or may be addressed to him, under cover, to the Smithsonian institution, Washington.

Manual training, the solution of social and industrial problems. By CHARLES H. HAM. New York, Harper, 1886. 12°.